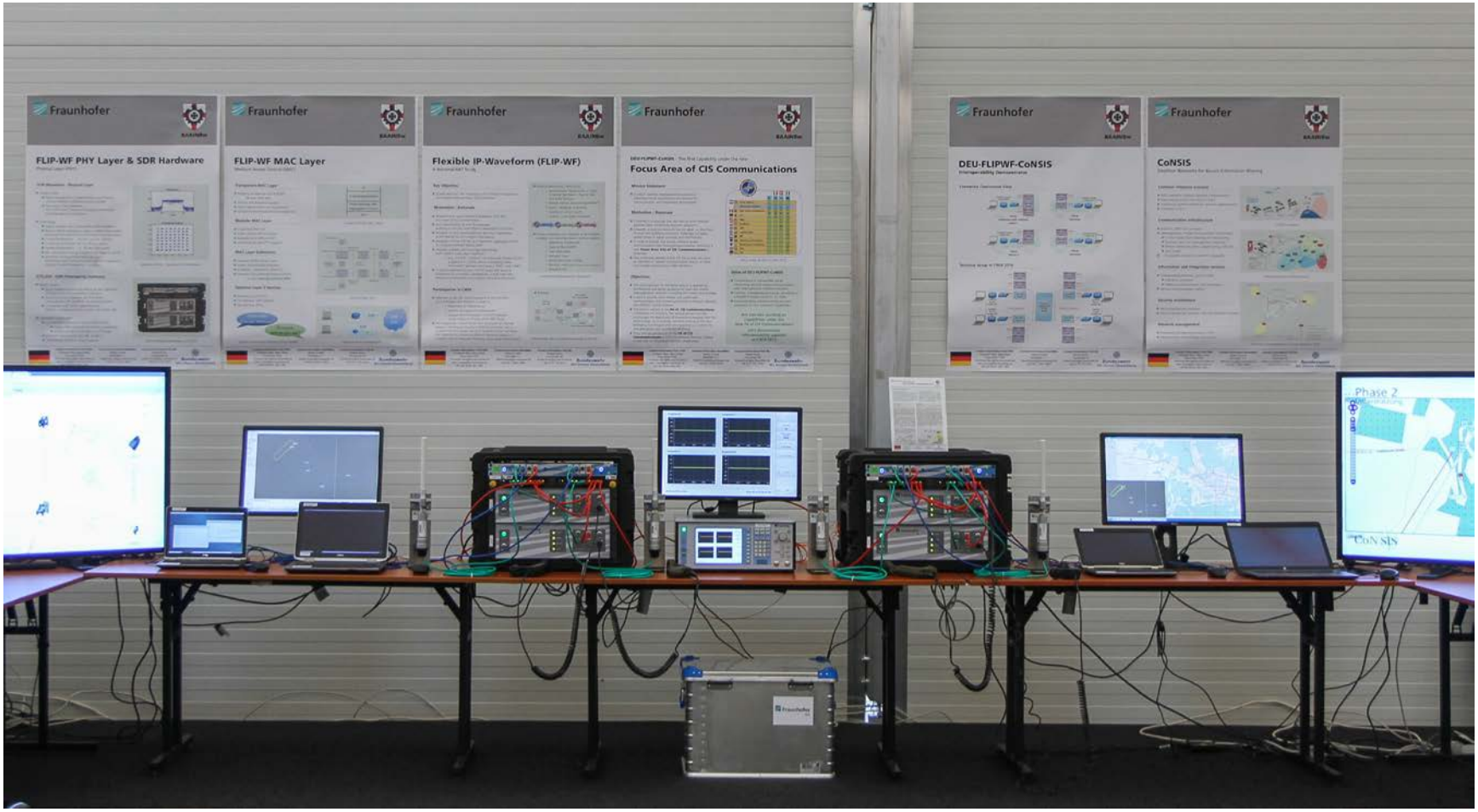
TACTICAL NETWORKING EXPERIMENTS AT THE CWIX

WInnComm-Europe
Oulu, May 17th 2017

Fraunhofer
FKIE

Christoph Barz – christoph.barz@fkie.fraunhofer.de,

CWIX 2016
FLIP Advanced Waveform Prototyping using SDR



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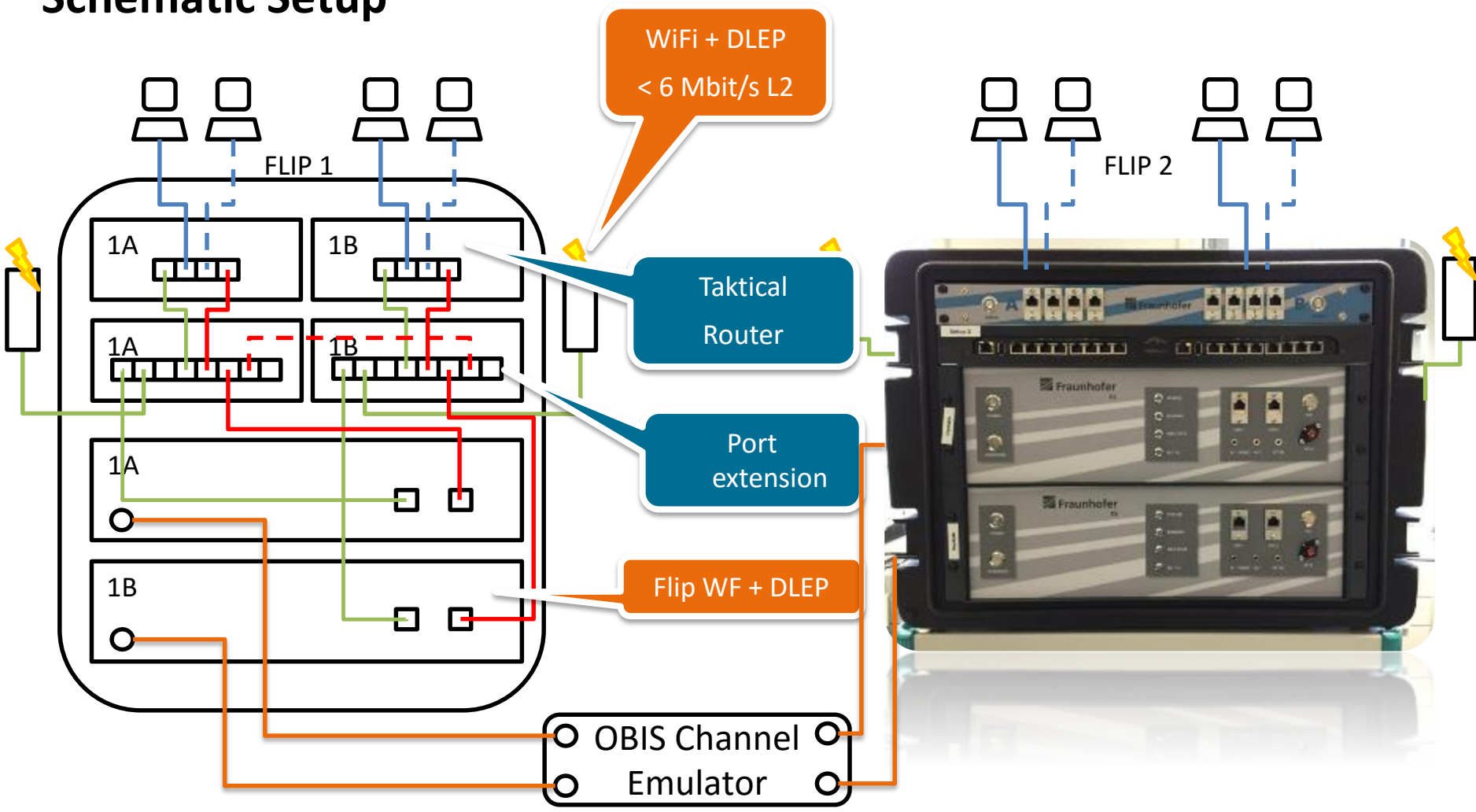
CWIX 2016
Schematic Setup



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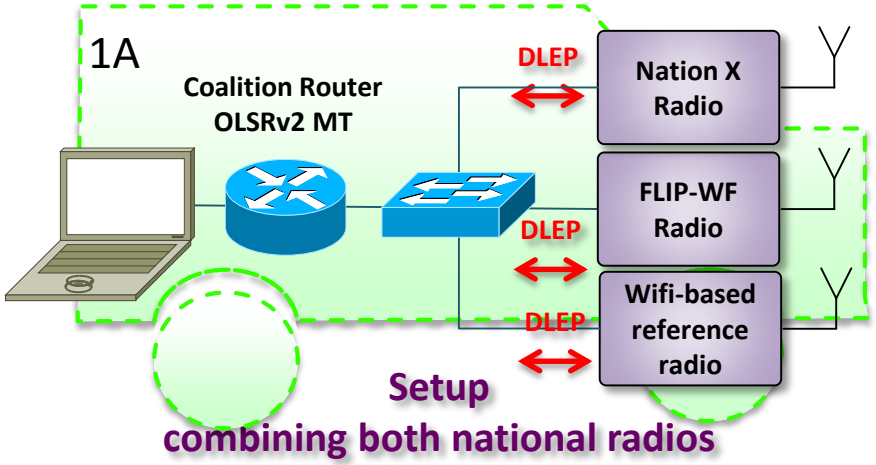
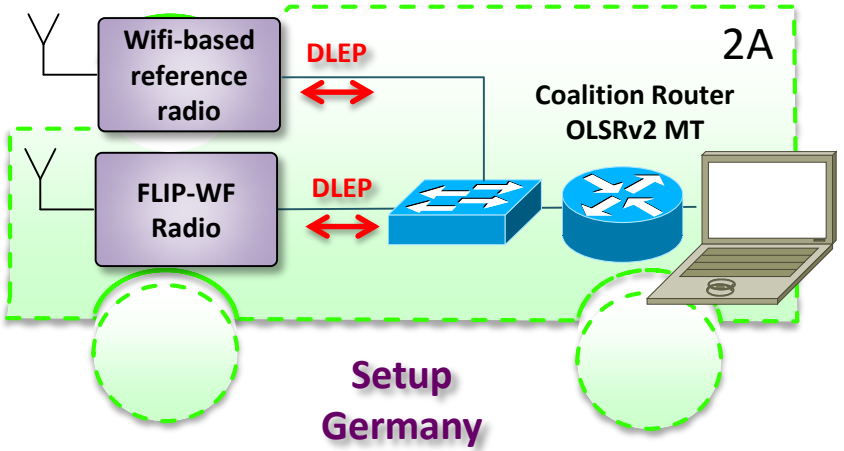
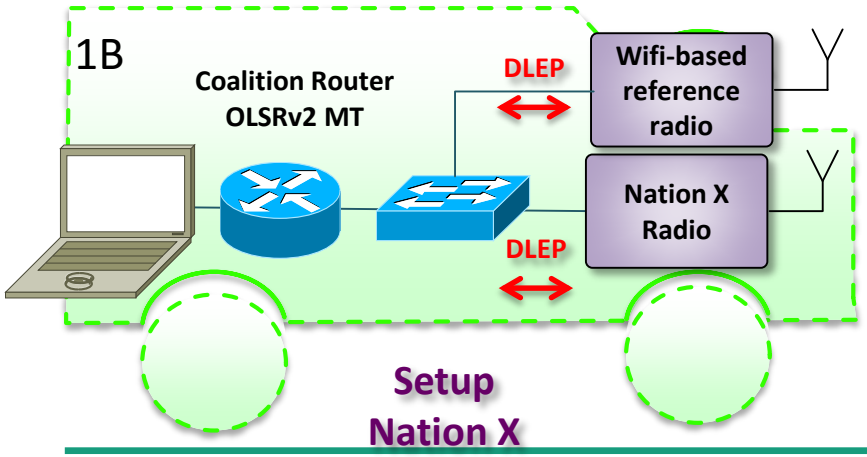
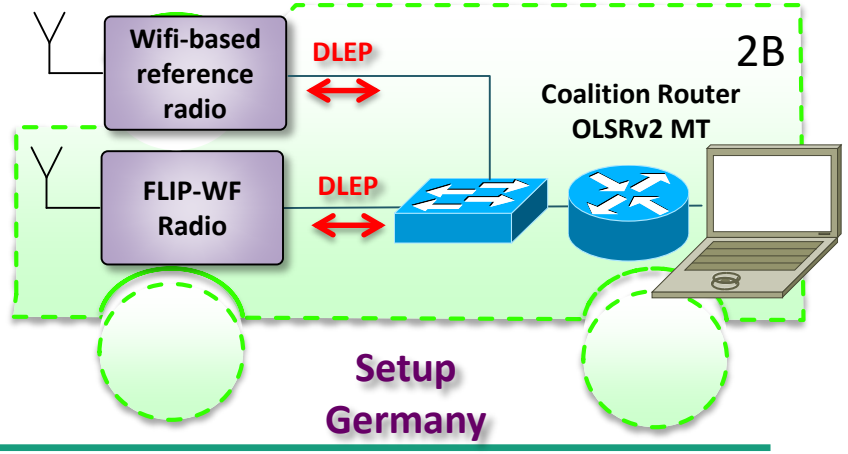
CWIX 2016
OLSRv2 & DLEP









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Routing & QoS in heterogeneous tactical Networks

Approach:

Technology-Aware MTR

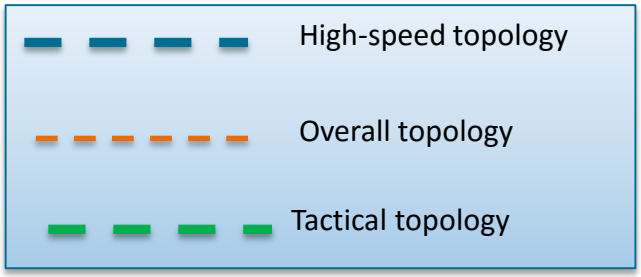
*Topologies represent **link characteristics***

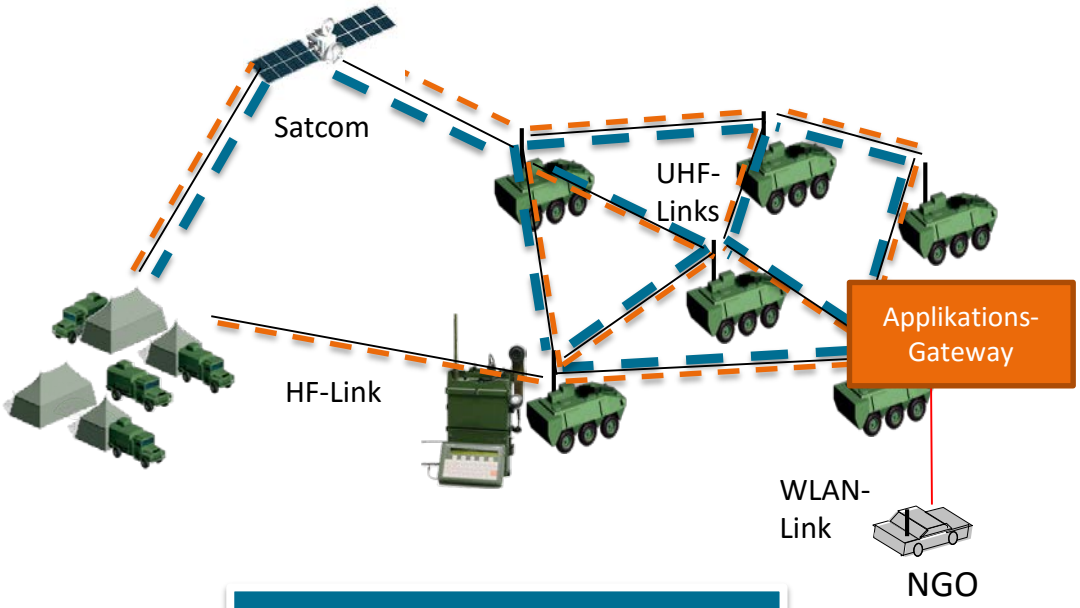
Applications are mapped to topologies

Role Based MTR

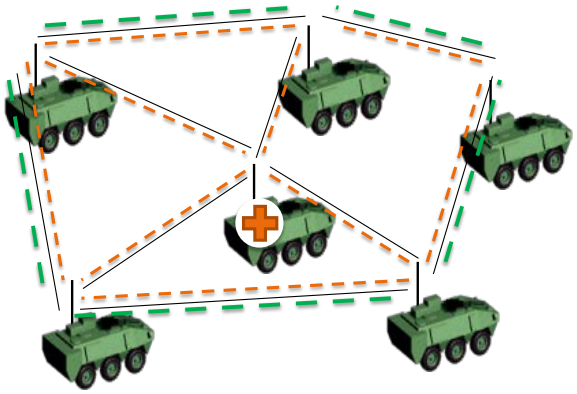
*Medics **do not forward tactical information***

*Medics can **still receive tactical data,** forwarding is prevented*





technology based MTR



role-based MTR

www.consis.info
-> QoS concept for QUAKSBw

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Open Architecture for heterogeneous tactical Routing

OSLRv2 as first instance of new generation of routing protocols

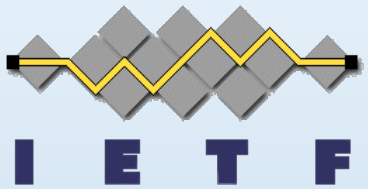
- modular
- scalable
- extensible

IETF – Directional Airtime Metric (DAT) for Cross Layer Information

- Effective Data rates
- Link Error rates
- Basis for Network Awareness information

IETF - Dynamic Link Exchange Protocol (DLEP) for Access to Cross Layer Data

- Auto Discovery
- Neighbors
- Link Speeds
- Error Rates



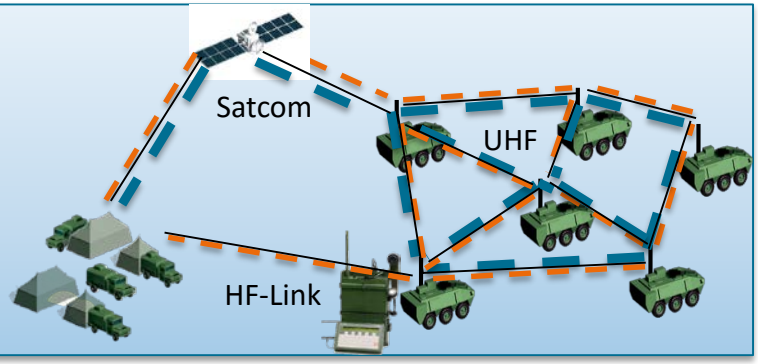
Fraunhofer FKIE main contributor to OLSR.org network framework (OONF)

OLSRv2 Military Extensions by Fraunhofer FKIE

Compatible with standard OLSRv2 nodes

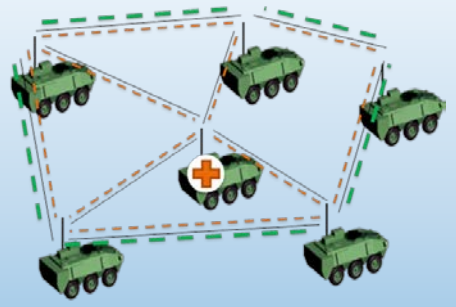
Technology-Aware MTR

- Application **data** must **match link characteristics**
- e.g. VHF not for high data rate applications
- Interface selection **independent of routing metric**
- Allows for the same routing metric for all topologies



Role Based MTR

- Medics **do not forward tactical information**
- Decoupling of topology participation and forwarding
- Medics can **still receive tactical data** while forwarding is prevented



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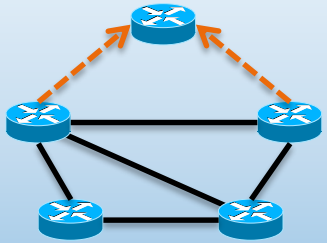
OLSRv2 Military Extensions by Fraunhofer FKIE

Artillery Observer Scenario

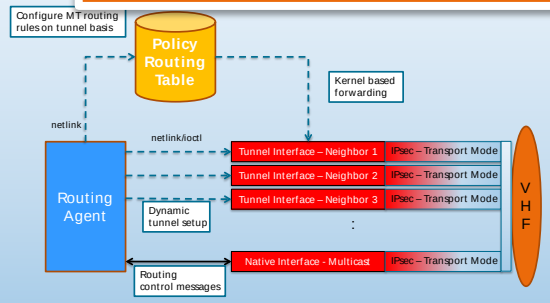
- Planned **EMCON**
- Reception of orders and information still vital for operation
- Observers can have several proxies
- **Network topology can change** as long as proxies stay in range



Security & Interoperability

- **Routing dynamically establishes tunnels** to direct neighbors
- Tunnels are basis for **Integration of MOTS Radios**
- **Optional Security** by IDP/MIKE integration per interface

ICMCIS 2015
"Advanced Security Gateways for Heterogeneous Tactical Ad hoc Networks."



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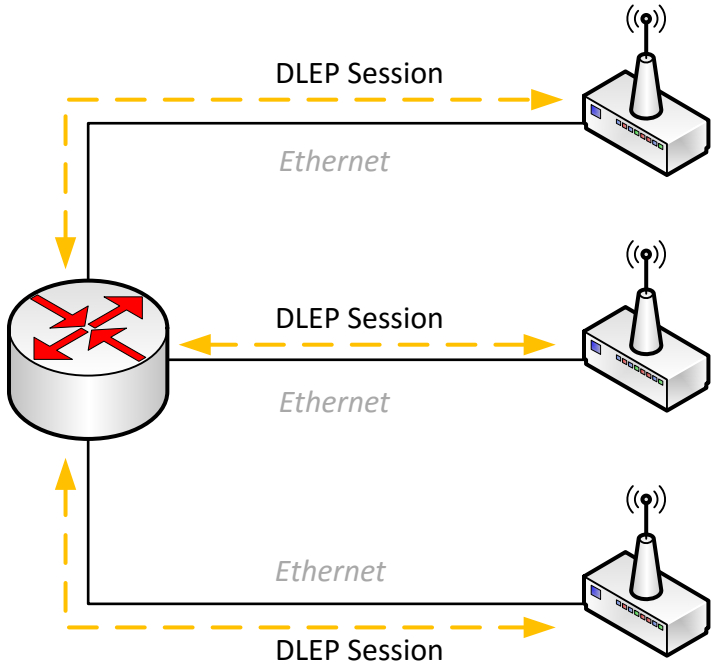
Flexible Architecture for Waveform Integration

Approach

- radios in a simple L2 mode
- single routing instance
- L2 information via Radio2Router prot.
- routing metric to incorporate link characteristics



Advantages

- reduced topology complexity
- less management overhead
- Interoperability / integration of different radios
- more flexibility in routing

“Radio Device Requirements“
www.consis.info

Research on a novel Flexible IP-Waveform (FLIP-WF) for future Tactical Environments

- **Early identification of new technologies**
  enabling a cost and time efficient **experimental assessment**
- Realization of the **FLIP-WF as a Waveform Application (WFA) for Software Defined Radios (SDR)**.
- **Modular, scalable, and reconfigurable Design**
  with modern **Cross Layer Interfaces (e.g. DLEP)**
- **Tailored parametrization and features** for different use cases
- Provision of **new operational and technical capabilities**
  to the warfighter (e.g. in Coalition Operations)
- CWIX activities for **Coalition Interoperability**

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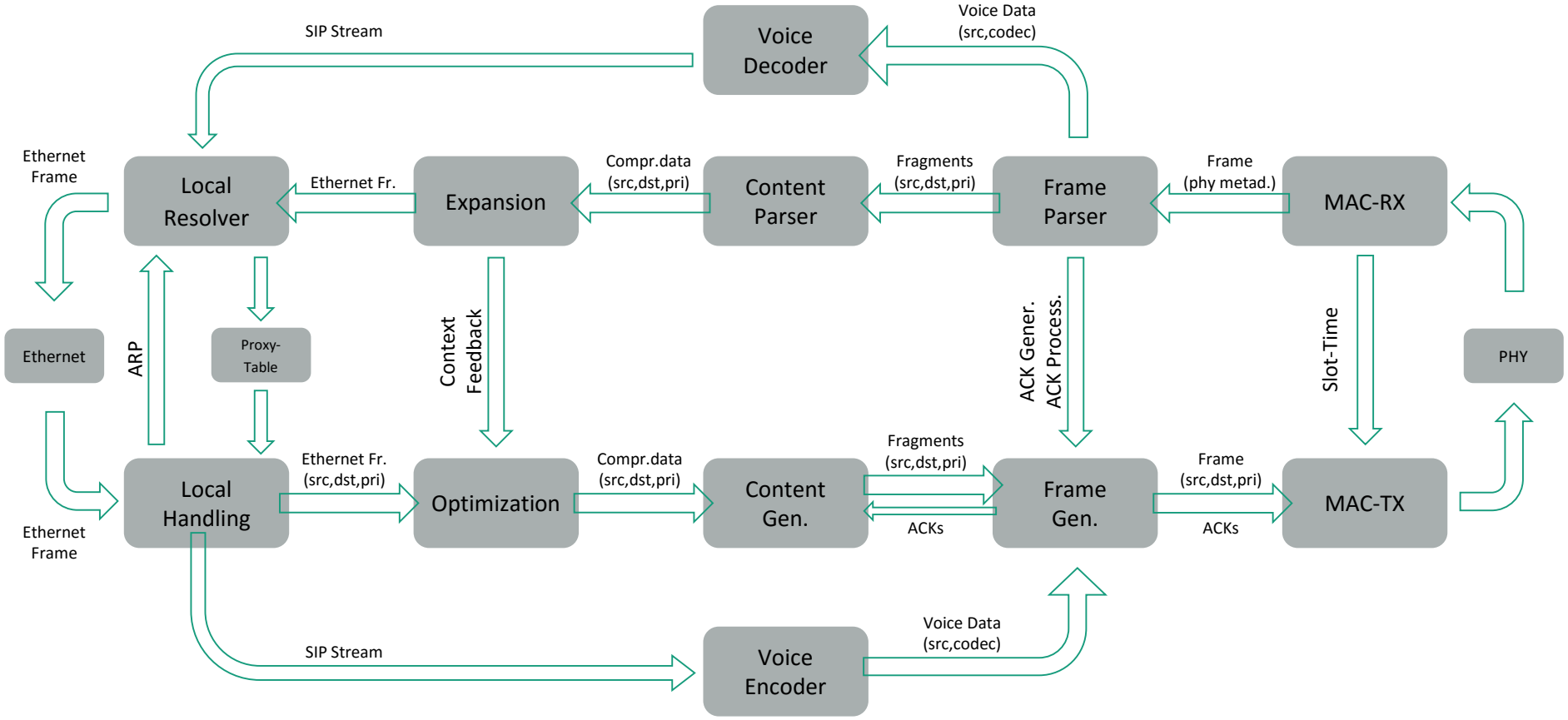
Flexible/Modular MAC – Version 0.6 (inline voice)



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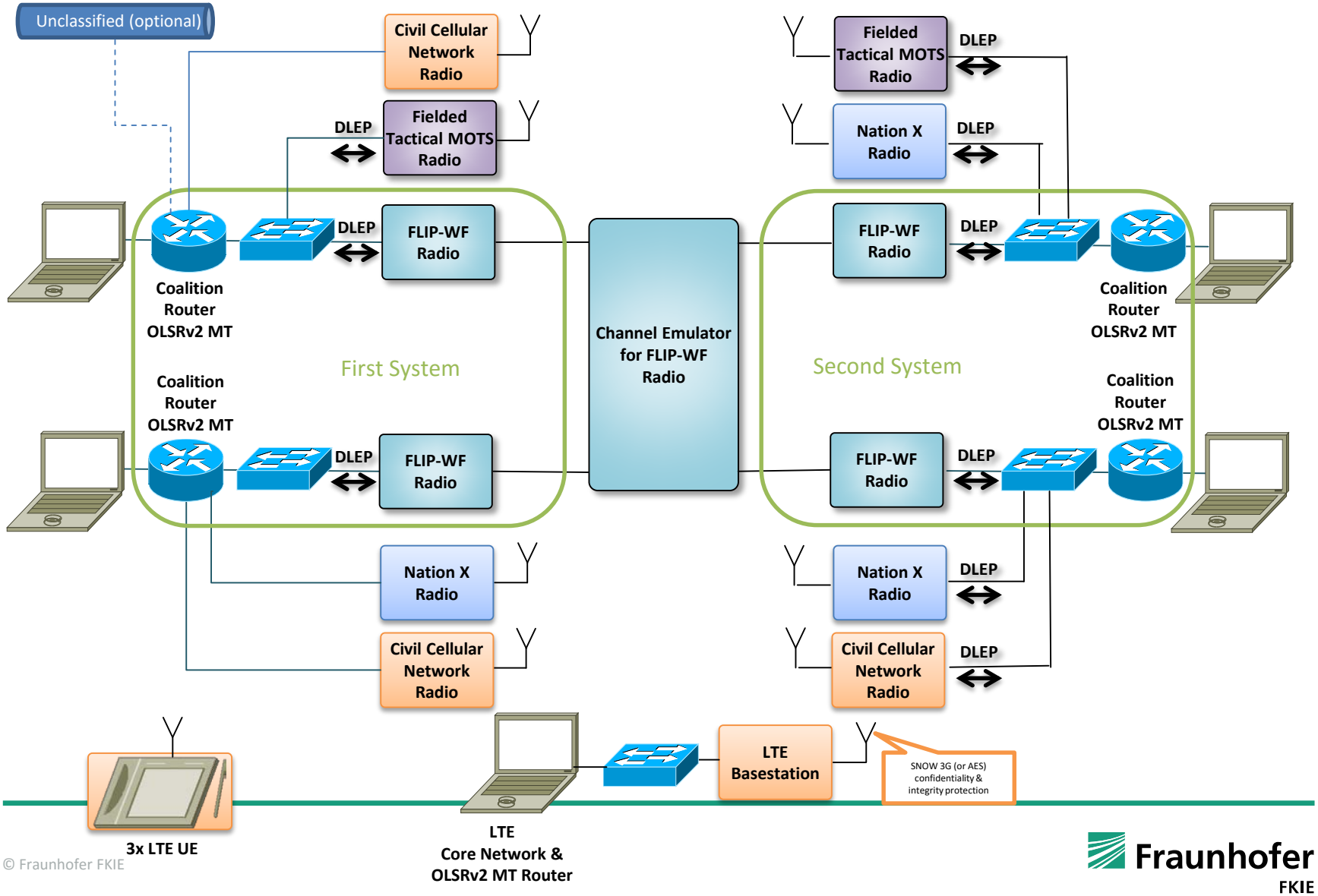
CWIX 2017 Network Setup



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CWIX 2017 - Capability

FIST-TacService Support	Tactical Service Support
Organization/ Capability Configuration Lead:	BAAINBw I1.1 – TRAR Detlef Staufenbiel Fraunhofer FKIE – Christoph Barz
Description:	Network status interface and QoS mechanisms for heterogeneous radio networks
Status:	F&T
Test objectives:	• Network awareness for applications • Network QoS mechanisms for military applications
Test motivation:	Test of interfaces between military applications and heterogeneous/multi-national tactical networks
Focus Area	Communications
Potential test partners:	NOR, USA, NATO

CWIX 2017 - Capability

FIST-TacRouter	Tactical Router
Organization/ Capability Configuration Lead:	BAAINBw I1.1 – TRAR Detlef Staufenbiel Fraunhofer FKIE – Christoph Barz
Description:	OLSRv2 (Optimized Link State Routing Protocol v2) based tactical router for heterogeneous tactical networks, Support for IETF DLEP (Dynamic Link Exchange Protocol) and IPSec-based security extensions
Status:	F&T
Test objectives:	• Interoperability with different tactical radios (Layer 2/Layer 3) • Interoperability of DLEP • Interoperability of OLSRv2
Test motivation:	Interoperability for coalition missions
Focus Area	Communications
Potential test partners:	BEL, NOR, POL, ROU, USA, NATO

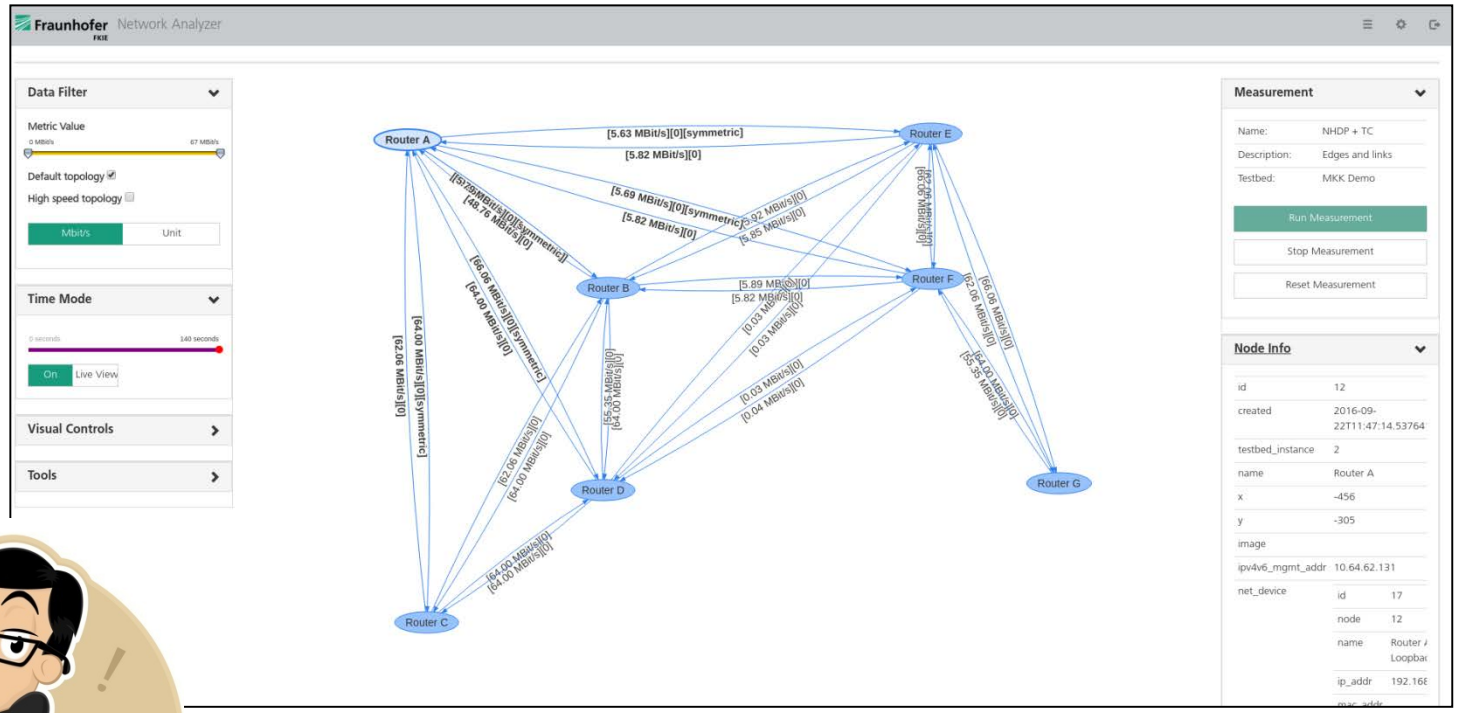
CWIX 2017 - Capability

FLIP-TacMAC	Flexible MAC-layer for tactical radios
Organization/ Capability Configuration Lead:	BAAINBw I1.1 – TORR Martin Dunkel Fraunhofer FKIE – Christoph Barz
Description:	Flexible Medium Access Control (MAC) Layer of a waveform for Software Defined Radios with modular design and extensions like DLEP; reusable for different PHY layers
Status:	F&T
Test objectives:	• MAC-layer features for simultaneous voice and data, QoS and flexibility • Interoperability test regarding physical layers
Test motivation:	Interoperability for coalition missions
Focus Area	Communications
Potential test partners:	NOR, BEL

CWIX 2017 - Capability

FLIP-TacPHY	Flexible physical-layer for tactical radios
Organization/ Capability Configuration Lead:	BAAINBw I1.1 – TORR Martin Dunkel Fraunhofer FKIE – Dr. Marc Adrat
Description:	Physical (PHY) layer of a waveform for Software Defined Radio with flexible scalable- and configurable parameters (e.g. burst length, bandwidth, modulation & coding schema)
Status:	F&T
Test objectives:	• Capabilities of the physical layer (e.g. adaptive Coding and modulation schema) • Interoperability to MAC layer
Test motivation:	Interoperability for coalition missions
Focus Area	Communications
Potential test partners:	BEL

Questions?



Live visualization based on the network awareness interface

… thanks!

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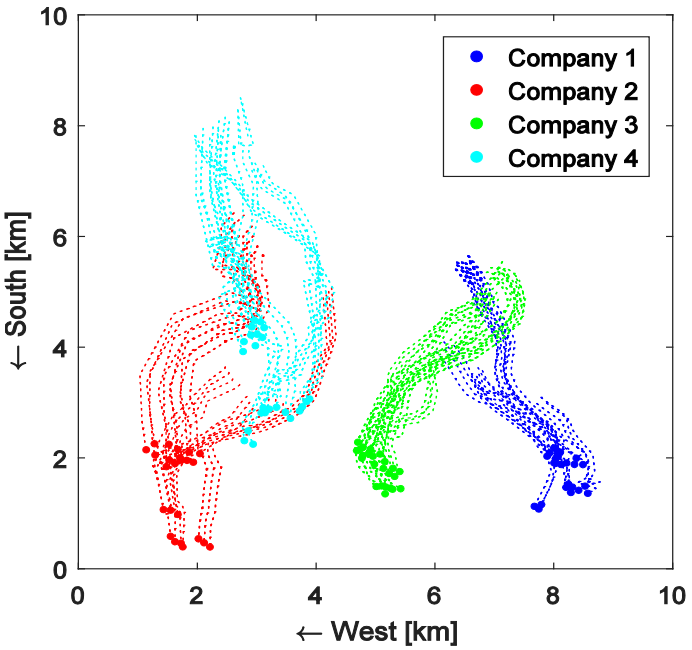
Overhead Analysis in a Military Scenario IST-124 Anglova Scenario

- Vignette 2; About 2 hours; Battalion of 157 nodes plus a Coalition Head Quarter (CHQ) and a UAV
- Hilly terrain covered by forests
- A segment, from 5500 to 6501 seconds in vignette 2 is used
- The battalion splits up further onto many paths grouped in companies
- Networks formed out of 1 to 4 companies
- Network sizes; 24, 48, 72 and 96 nodes
- Mobility, up to 60 km/h



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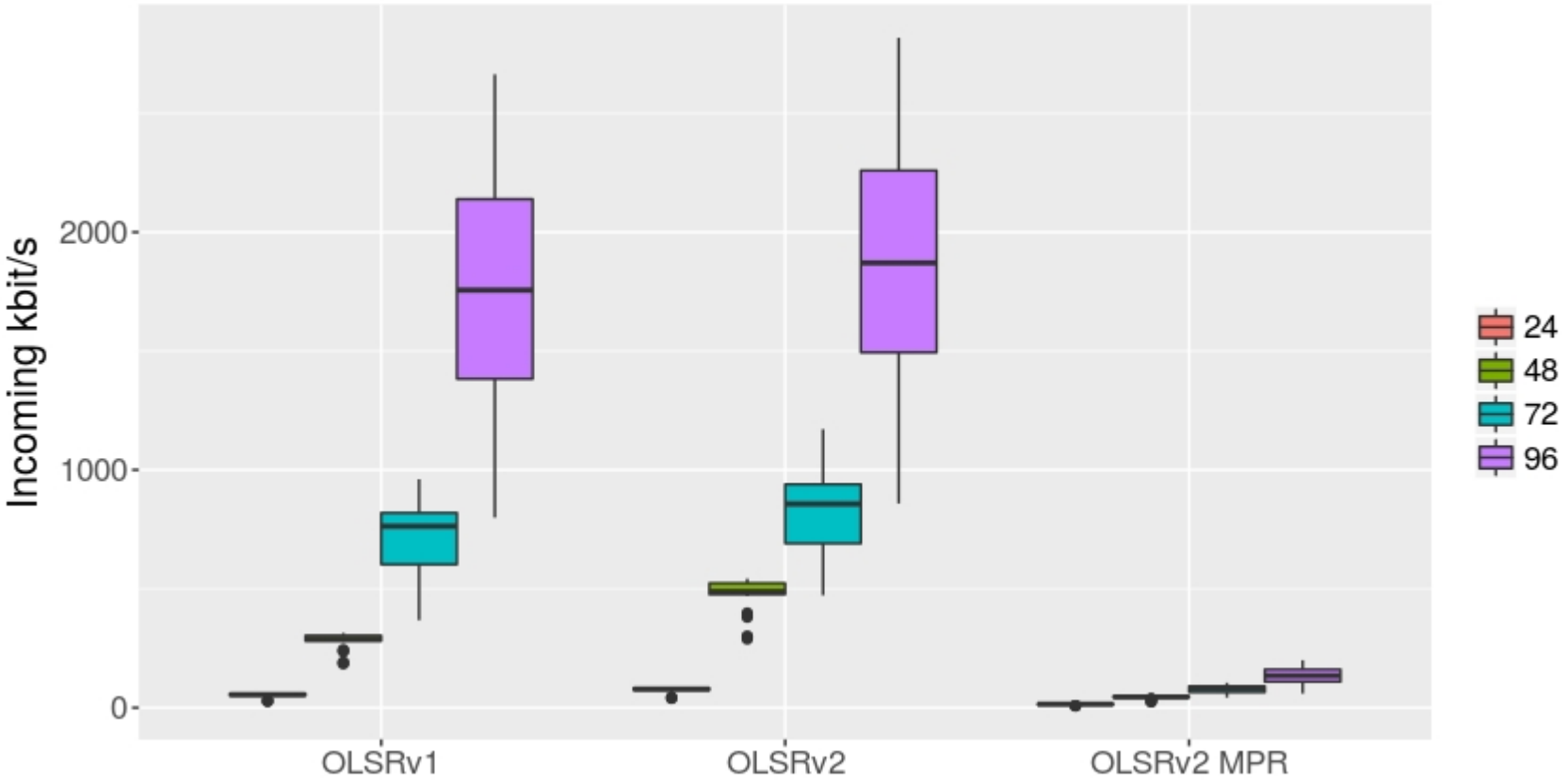
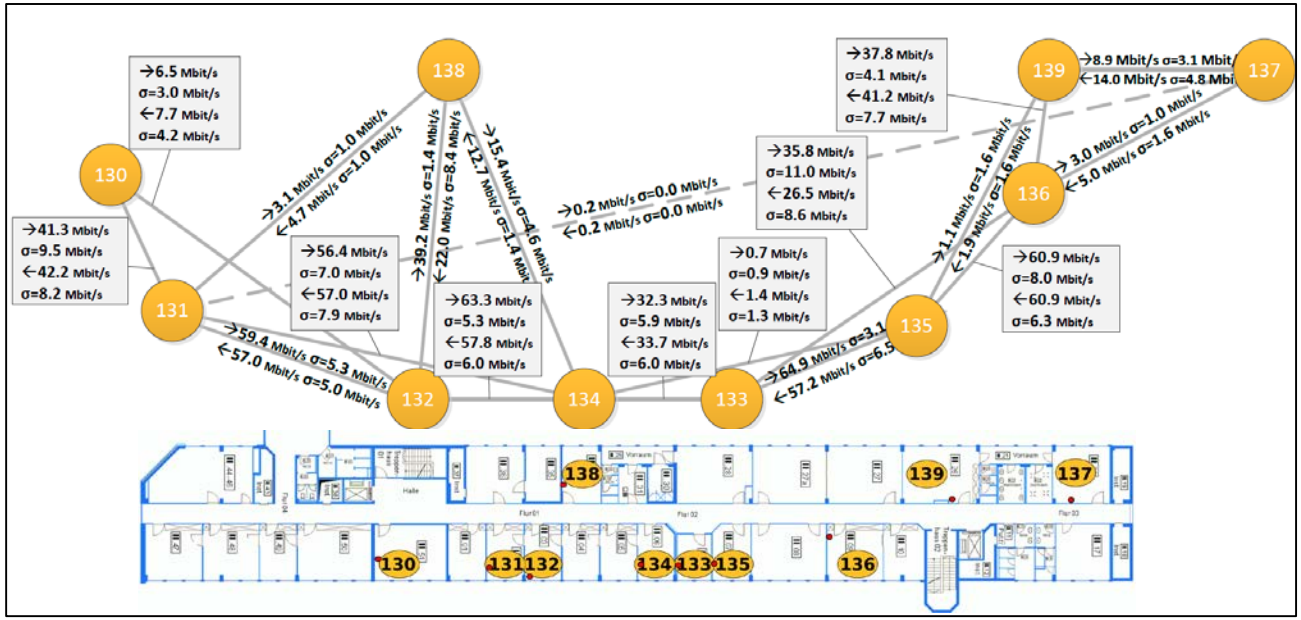
Overhead Analysis in a Military Scenario IST-124 Anglova Scenario

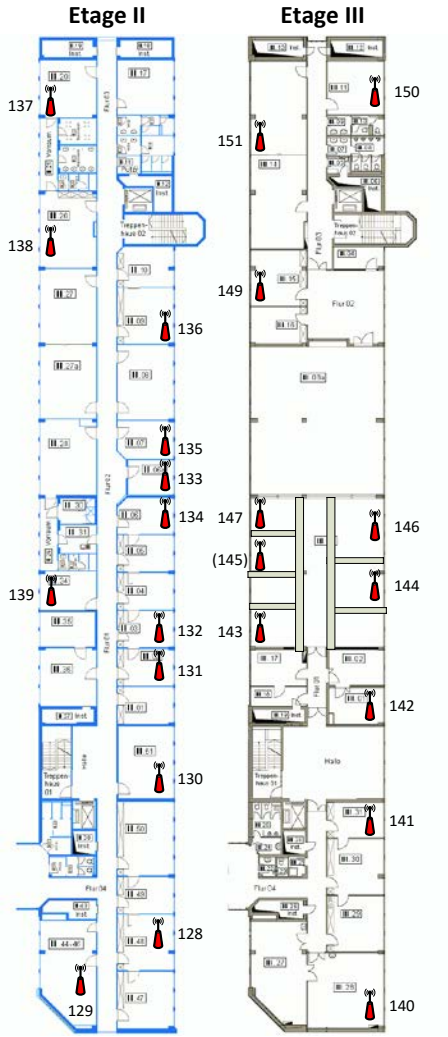


DLEP based Testbed at Fraunhofer FKIE

OLSRv2 for Community Networks.
Elsevier *Comput. Netw.* 93
December 2015

- FKIE testbed extensions - two floors, 100m approx.
- 26 locations in a dense indoor deployment, each with:
  - Radio devices with 12dbi 5Ghz antenna
  - Experiment devices (e.g. running OLSRv2 with DAT metric)
- OLSRd / OLSRd2 backbone network





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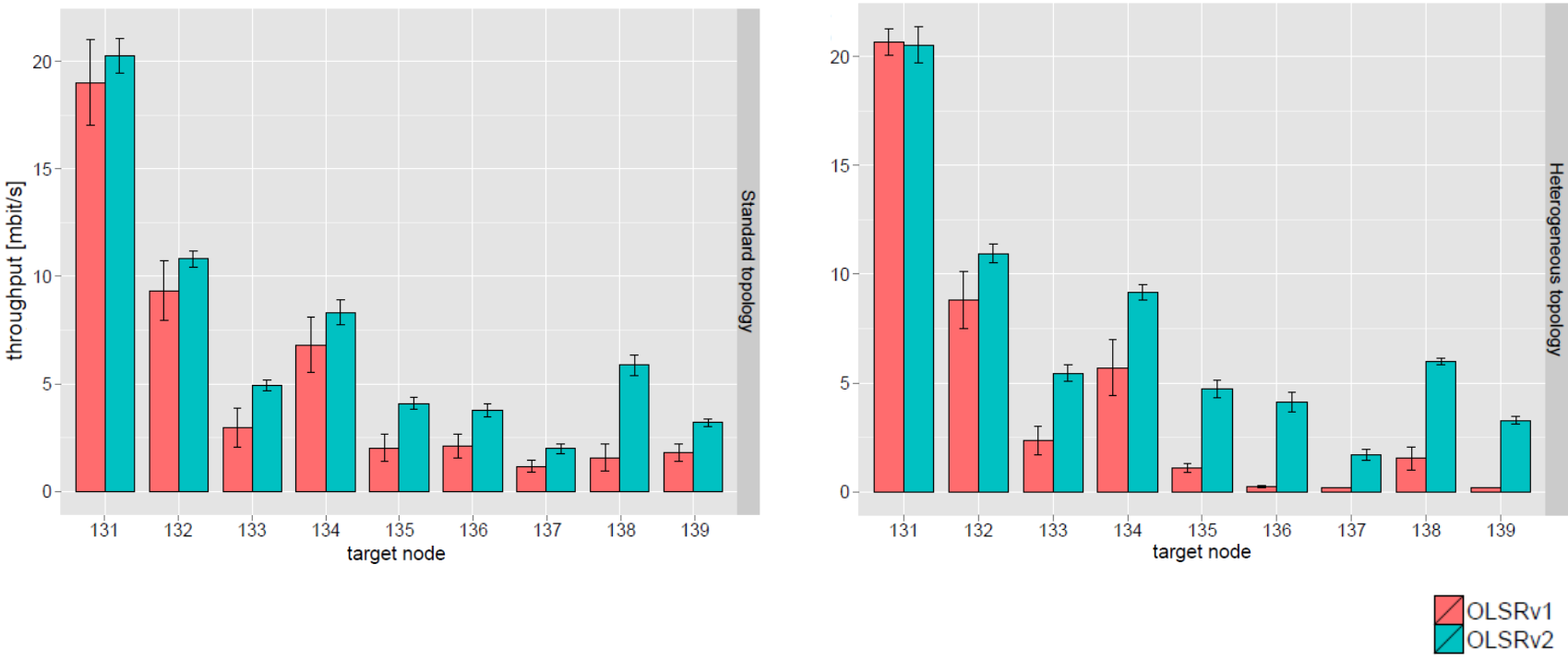
OLSRv2 with DLEP – Testbed Results

Experiment: TCP throughput measurements
- From node 130 to node X
- 20 replications
- 0.95 confidence level



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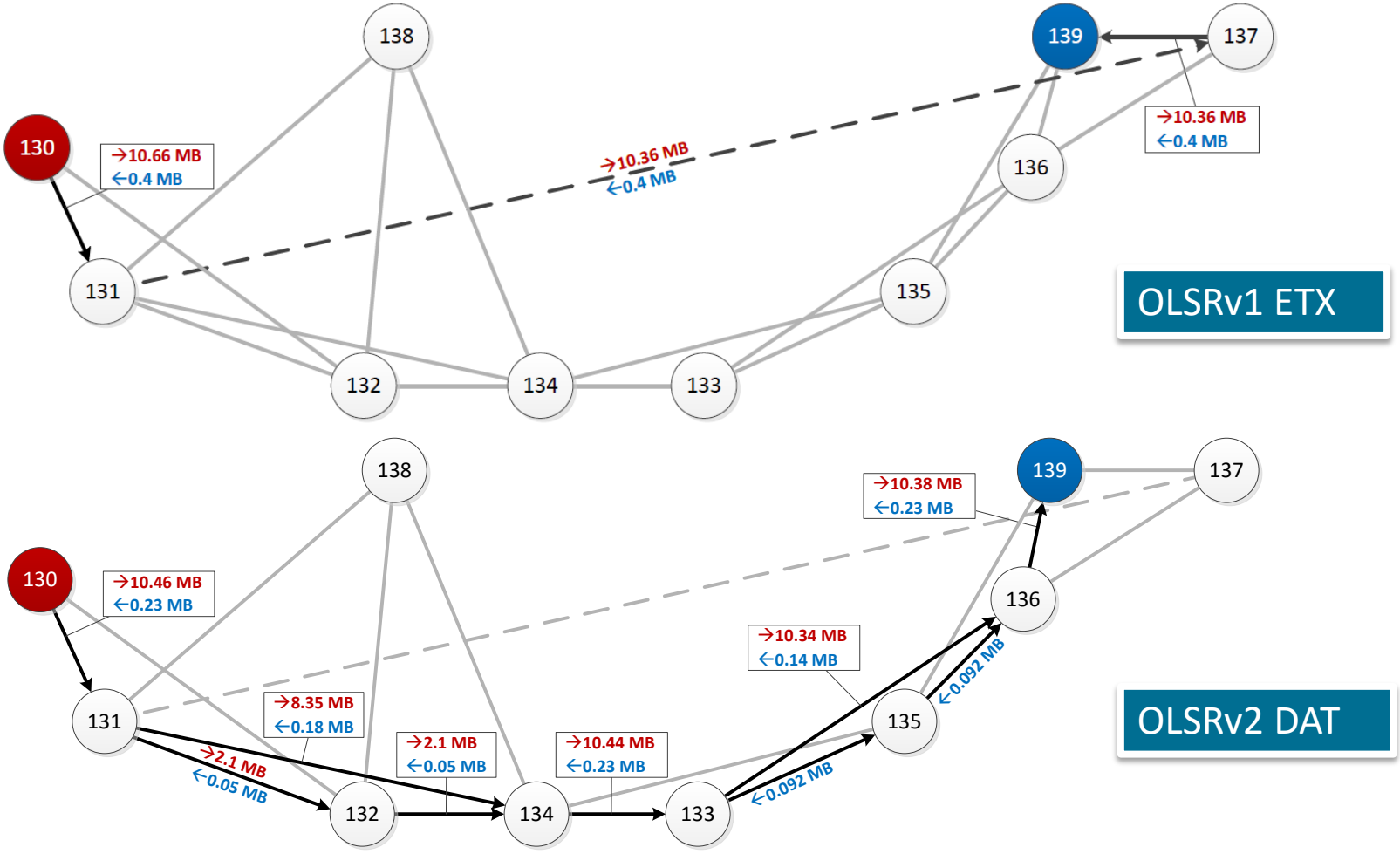
Difference of OLSRv1 ETX and OLSRv2 DAT Strategies



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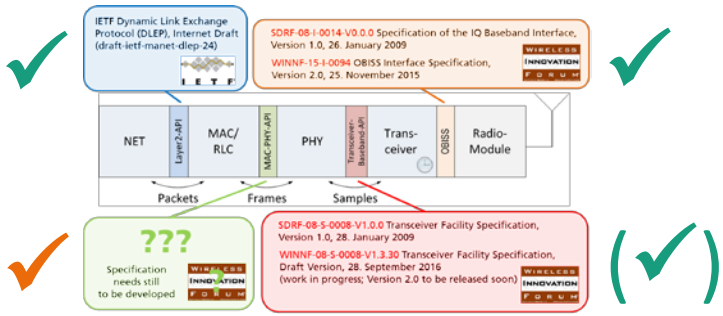
Short Introduction to our National R&T Study – Rapid Prototyping with a Flexible IP-capable Waveform

- PHY
  - OFDM, 25-100 kHz BW
  - Tactical VHF / UHF bands
- MAC
  - CSMA with reserved slots for CNR-PTT-style voice transmission
- Link layer
  - Transparent Bridging
  - IPv4 & v6 capable (layer 3)
- (optional) MANET
  - Dynamic Routing with OLSRv2
  - Dynamic Link Exchange Protocol



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